REMARKS

This amendment is responsive to the Office Action of May 17, 2004. Reconsideration and allowance of **claims 1-28 and 55-58** are requested.

The Office Action

Claims 1-3, 7-10, 28, 56-58 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Ohhashi (U.S. Patent No. 5,315,566) in view of Albert (U.S. Patent No. 4,144,457).

Claims 13, 16, 17, 18, 22, 23, 25 and 27 stand rejected under 35 U.S.C. §102(b) based on a prior public use or sale of Ohhashi (U.S. Patent No. 5,315,566). No evidence of any public use or sale of the Ohhashi apparatus was presented.

Claims 14 and 15 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Ohhashi (U.S. Patent No. 5,315,566) in view of Seki (U.S. Patent No. 5,754,623).

Claims 24 and 55 stand rejected as being not patently distinct from each other but are not rejected on prior art.

Claims 4–6, 11, 12, 19-21 were indicated as containing allowable subject matter.

Claims 18 and 26 do not stand rejected on art and are understood to be allowable.

The Present Application

The present application is directed to a method for modifying an image slice in a CT scanner having a predetermined reconstruction angle. The original image is modified and updated by incorporating attenuation data acquired in additional scan path sectors. The initial attenuation data and the attenuation data acquired during scans of additional sectors within the slice is compared to produce a difference matrix. More particularly, an additional set of data is subtracted out from the initial set of data. In one embodiment, the subtraction is performed on filtered and back projected initial and additional attenuation data. In another embodiment, the subtraction is performed on initial and additional attenuation data before filtering and

back projecting. A produced difference matrix is then filtered and back projected to the image.

In accordance with another aspect of the present application, a region of interest is defined by a use of a scanner or by a known software. The region of interest is defined to include an object of interest such as a needle or an organ. The position of the needle is tracked. The region of interest is periodically adjusted in response to changes in the position of the needle. Preferably, the movement of the needle is tracked using preprocessed attenuation data. A small sub-region is centered on the needle tip, in which the maximum value of the data is found. The window is then shifted so that the location of the maximum value is at the center of the window.

The References of Record

Ohhashi is directed to a spiral CT system which allows reconstruction of an operator selected transverse slice. The helix cuts a selected slice at a single point. The data collected in the 360° before and after that point are used to reconstruct the image of the selected slice. More specifically, views at an m-th slice position are obtained by interpolating 360° views in a range next to the slice position in a forward direction in which the slice position number increases and 360° views in a range next to the slice position in the backward direction, and m-th tomographic image is reconstructed based on the interpolated views at the m-th slice position. An m-th backward image (mBI) is reconstructed based on the 360° views in the range next to the m-th slice position in the backward direction without interpolation and an m-th forward image (mFI) is reconstructed based on the 360° views in the range next to the m-th slice position in the forward direction without interpolation. By using a pointing device such as a mouse, images of the respective slice positions can be continuously displayed to allow continuous observation of the interior of a human body. The display device of an X-ray CT apparatus displays a scannogram together with a vertical line ROI cursor superimposed on the scannogram. The display position of the ROI cursor is moved by a mouse. The slice position is matched with the position of the vertical line ROI on the scannogram. An image number m corresponding to the cursor position is updated.

Albert is directed to the tomographic X-ray scanning system. By repeating the scanning process in a series of adjacent planes, data for generating a three-dimensional X-ray image of the subject is updated. In one embodiment, additional scanning X-ray sources, additional detectors and additional cameras are employed to receive additional sets of data.

Seki is directed to a radiotherapy planning system based on the images. A radiotherapy planner produces, on the basis of the image data, the radiotherapy plan including position data of an isocenter.

The Claims Distinguish Patentably Over the References of Record

Claim 1 calls for reconstructing an image from X-ray attenuation data collected over a plurality of sectors which each have an angular extent substantially less than the reconstruction angle. This image is then modified in accordance with a difference between the radiation attenuation data collected in one of the sectors within the initial subset of detectors and one of the sectors outside of the original subset of detectors. Neither Ohhashi nor Albert disclose or fairly suggest modifying a reconstructed image based on the difference between a subset of radiation data which went into the image and a subset of radiation data which was not part of the original image. Accordingly, it is submitted that **claim 1 and claims 2 and 3 dependent therefrom** distinguish patentably and unobviously over the references of record.

Claim 4 was indicated as containing allowable subject matter. Accordingly, it is submitted that **claim 4 and claims 5-8 and 14-15 dependent therefrom** distinguish patentably over the references of record.

Claim 10 has been rewritten in an independent form. Claim 10 calls for, among other limitations: processing the additional attenuation data and the initial attenuation data to produce a difference image data matrix which represents a difference between corresponding initial attenuation data and additional attenuation data. Ohhashi discloses a CT system which allows reconstruction of the images at a large number of consecutive slice positions. The additional attenuation data is obtained in forward and backward directions of the slices immediately adjacent to the current slice position. To the contrary, the present application is directed to modifying a particular slice of an image data. To begin with, an initial attenuation

data of the image slice is acquired. Additional attenuation data is acquired in the vicinity of the axial position of the slice. The initial attenuation data and additional attenuation data, both corresponding to the same slice, are processed to derive a difference image matrix by a process of subtraction. The difference matrix is then added to the image. None of the references taken singularly or in combination discloses or suggests creating a difference image data matrix, which is derived by subtraction of one data set from another. It is, therefore, respectfully submitted that **claim 10** distinguishes patentably and unobviously over Ohhashi and Albert.

Claims 11 and 12 were indicated as containing allowable subject matter. Accordingly, it is submitted that **claims 11 and 12** are now in condition for allowance.

Claim 13 calls for reconstructing a CT image in which a region of interest is defined. The region of interest encompasses only a portion of the reconstructed image. Then, the CT image is updated ***only*** in the region of interest. Ohhashi does not teach or fairly suggest updating only a selected portion of a reconstructed image. Rather, Ohhashi describes a technique in which spiral data can be reconstructed into a continuously selectable slice image. However, once that slice image is reconstructed, Ohhashi makes no suggestion of updating only a portion of it. Accordingly, it is submitted that **claim 13 and claim 56 dependent therefrom** now distinguishes patentably and unobviously over the references of record.

Claim 18 has been rewritten in an independent form. Claim 18 calls for, among other limitations: defining a region of interest to include an object of interest. Ohhashi discloses a CT system in which by the use of a mouse images of the respective slice positions can be continuously displayed to allow continuous observation of the interior of a human body. The display device displays a scannogram which shows a vertical line ROI cursor superimposed on the scannogram. The display position of the ROI cursor is moved by a mouse. When the mouse position is changed, the amount of change is detected, and the different slice is displayed. In contrast, the present application is directed to defining a region of interest within an image slice such that the region of interest includes an object of interest.

Further, claim 18 calls for changing the region of interest reconstruction in response to movement of the object is tracked. The region of interest is shifted depending on the movement of the object. As a result, the CT image is updated only in the region of interest. Ohhashi does not disclose or suggest defining a region of interest which is shifted based on the tracking of the object identified in the region of interest such that only the region of interest is updated during reconstruction. None of the references taken singularly or in combination discloses or suggests defining a region of interest which includes an object of interest and adjusting the region of interest based on the movements of the object located within the subject. It is, therefore, respectfully submitted that **claim 18** and **dependent claims 16, 17, 19-22 and 24** distinguish patentably and unobviously over Ohhashi.

Claim 23 calls for a method of determining the optimal position for CT slices. In Ohhashi, the operator moves a cursor and manually selects slice position. Further, claim 23 calls for reconstructing multiple slices which include a region of interest and then determining the position of an object within the region of interest. Ohhashi has no means for determining the position of an object within the region of interest. Moreover, claim 23 calls for monitoring movement of the object. Ohhashi does not suggest any software routine or other means for monitoring object movement.

Finally, claim 23 calls for moving the region of interest to track the movement of the object. Again, Ohhashi does not provide any software or other means for moving the region of interest in response to movement of a monitored object. Accordingly, it is submitted that **claim 23** distinguishes patentably and unobviously over the references of record.

Claim 26 does not stand rejected on art and accordingly, is understood to contain allowable subject matter. Claim 26 has been placed in independent form. Accordingly, it is submitted that **claim 26 and claim 57 dependent therefrom** are now in condition for allowance.

Claim 28 calls for monitoring X-ray attenuation through a region of interest and then modifying the reconstructed image in response to changes in the monitored X-ray attenuation. By contrast, Ohhashi generates a spiral scan of data. In a post-processing operation, Ohhashi interpolates the previously taken attenuation

data to generate slices at selected positions. There is no continued monitoring of attenuation data and changing the reconstructed image in response to the monitored attenuation data. Rather, Ohhashi changes the interpolation in response to a selected slice position. Accordingly, it is submitted that **claim 28 and claim 58 dependent therefrom** distinguish patentably and unobviously over the references of record.

Claim 55 was rejected as being not patentably distinct from claim 24, but does not stand rejected on prior art. Accordingly, it is understood that claim 55 contains allowable subject matter once the redundancy is resolved. Claim 55 has been placed in independent form while **claim 24** has been amended to depend from new independent claim 18. The scope of claim 24, which now includes the subject matter of claim 18, differs significantly in scope from claim 55. Accordingly, claims 24 and 55 are now patentably distinct. An early allowance of **claim 24 and claim 55** is requested.

CONCLUSION

For the reasons set forth above, it is submitted that **claims 1-24, 26, 28 and 55-58** (all claims) distinguish patentably over the references of record and meet all statutory requirements. An early allowance of all claims is requested.

In the event the Examiner considers personal contact advantageous to the disposition of this case, he is requested to telephone Thomas E. Kocovsky at (216) 861-5582.

Respectfully submitted,

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